International Commercial
Experiments Service

Making access for space
experiments
FAST
SIMPLE
ATTRACTIVE
and AFFORDABLE
for research, technology, education
and capacity building

COPUOS Scientific and Technical
SubCommittee 55th session

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ICE Cubes Introduction

The **International Space Station** (ISS) is a great international achievement, designed as a flexible laboratory able to support research in a wide range of disciplines.

Based on a public–private partnership agreement with the European Space Agency (ESA) the **International Commercial Experiment (ICE Cubes) service** is providing **fast, simple and affordable access for experiments** to the International Space Station, creating **capacity-building opportunities for any country or any entity / user.**
ICE Cubes Introduction

The ICE Cubes service is suitable to provide access to space for many uses:

- Fundamental and applied research / university studies (Bachelor, Master and Doctoral theses)
- Industrial R&D for e.g. pharmaceutical, biotechnology & food, cosmetics, soft matter & coatings and petroleum industry allowing to address sustainability-oriented R&D areas
- In-orbit testing and validation of technologies and processes
- Participating in human spaceflight exploration preparation activities
- Educational experiments and demonstrations in the science, technology, engineering and mathematics (STEM) areas
ICE Cubes Introduction

ICE Cubes service allows any country, any institute or any entity to directly develop and conduct their experiment on the International Space Station, the only laboratory in space.

Users can develop their own Experiment Cubes according to a specific set of interface and safety requirement documents. They will remain owners of their experiments and results.
ICE Cubes Microgravity Research

This platform allows for **microgravity / space research** in areas relevant to **sustainable development**. Microgravity research allows the study of phenomena and processes that cannot be observed on Earth, hidden by the gravity vector factor.

Some examples:

- **Additive manufacturing / 3D (bio-)printing**
- **Drugs R&D optimisation and testing**
- **Investigation of food production & processes**

- Increased understanding of **plants and micro cultivation systems** behaviour in space to increase production / improve quality of food on Earth
- **microfluidic lab on a chip applications** in cell, molecular, plant biology / microbiology, pharmaco-chemical research
ICE Cubes in the context of capacity building

1. Offer the **opportunity to address research goals** related to **sustainable development** and to be informed on its potential in space / microgravity.

2. Offer **capacity building opportunity specifically in R&D experiment development** and execution with ad-hoc fine-tuned support for development.

3. Allow **to position in the economic Low Earth Orbit (LEO) ecosystem** of organizations / companies / start-ups. Lower cost enables lower entry barrier.

4. Offer a **platform of appropriate / affordable size** to be used for start-ups / pilot projects / university projects.

5. Short **time from signing flight agreement to receiving results**.

6. Allow for **match-making collaborations**.
ICE Cubes Facility and Experiment Cubes

The launch of the ICE Cubes internal facility is planned in **spring 2018**.

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Demo Model can be visited today in front of Boardroom D
ICE Cubes Service characteristics

- **Near real-time telemetry and telecommand**
- Commanding and data reception directly from/to the various user home bases

- To control their Experiment Cubes, users are provided with an out-of-the-box software suite composed of VPN client, FTP client, Web browser, Mission Control System client and User manual.
ICE Cubes Service characteristics

<table>
<thead>
<tr>
<th>Time from agreement signature to launch</th>
<th>12 Month (typ)</th>
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<tbody>
<tr>
<td>Launch / return frequency</td>
<td>Every 4 months from spring 2018</td>
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**Standard Service includes:**
- basic Experiment Cube development guidance,
- interface testing,
- arranging experiment certification,
- launch,
- on-orbit installation,
- standard type operations support,
- as well as disposal after operation.

**Additional Service can include:**
- engineering support for development
- conditioned stowage
- late access to launch vehicle
- return of the hardware
- early access to return vehicle
- dedicated crew activities
- ....

The ICE Cubes service is willing to help less experienced organizations/countries, a.o. by arranging **info days and workshops** in situ.
With same focus of making **access** for space experiments **fast, simple** and **affordable** for **research, technology, education and related capacity building**
## ICE Cubes impact

<table>
<thead>
<tr>
<th>Socio-Economics</th>
<th>Allows for capacity building and innovation</th>
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<tbody>
<tr>
<td></td>
<td>Competence in a high tech sector of scientific / technical innovation value</td>
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<td>Spin-in / Spin-offs opportunities</td>
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<td>Industrial competitiveness</td>
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<td>Inspiring young generations for STEM and space</td>
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<td>Industry – Non Space</td>
<td>Prompt access to space and microgravity environment</td>
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<td>Industry – Space</td>
<td>De-risk innovation and accelerate development</td>
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<tr>
<td>Future Space Exploration</td>
<td>Enabling endeavour and participation to explore</td>
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Conclusion

• Through this way, the ICE Cubes service allows any entity to stimulate their capability to achieve research, social & economic goals.
• This allows for technological leap-frogging for emerging space countries.
• As such the ICE Cubes service provides for a very appealing key technological solution and innovative approach for capacity building by providing direct access to space for the broad community.

THANK YOU FOR LISTENING

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Back-up slides
ICE Cubes Service Characteristics

The ICE Cubes programme will establish:

- A permanent multipurpose facility (ICE Cubes Facility) on board the International Space Station allowing for the accommodation and exploitation of small payloads and experiments (Experiment Cubes)
- A set of special-purpose or repeated-use multi-unit Experiment Cube which can be used by multiple users (e.g. fluorescent microscope special cube)
- The ground infrastructure for the management of the ICE Cubes Facility and the Experiment Cubes
- The end-to-end service allowing utilization of the ICE Cubes Facility and of the aforementioned multi-unit Experiment Cube
- Ad-hoc engineering services (e.g. design, development, assembly, testing), as needed / desired.
Experiment Cubes characteristics

- **Power** profiles: 5V and 12 V, 10W per liter, up to 40.5 W max per Cube
- **Thermal** cooling: Forced air ventilation
- Operations: **Real-time** telemetry/telecommand to/from ground
- **Data**: Downlink up to 4 Mbps
  Uplink up to 0.5 Mbps
- Communications: standard **internet protocols (IPs)**
In the frame of the ICE Cubes Service special purpose Experiment Cubes will be developed provided with diagnostics to support different areas or research. The special cubes will remain on board the ISS and will temporary host replaceable experiment containers/cartridges. This approach aims at providing solutions for Cube level mini-facilities that may reduce cost of the development and launch of the various branches of experiments.

Currently undergoing a survey of the possible interests/requests by the potential users or at start of development are:

- Fluorescent microscope
- X-Ray diffractometer
- Organ-on-a-chip technology testbed
- Others under investigation
ICE Cubes Service Future Evolution

**Internal ISS Experiments**
- Specialized sub-facility labs with diagnostic capabilities
- Crew interaction applications

**External ISS Experiments**
- Facility for deployment of external payloads through ISS Airlock(s)

**Free flying and sub-orbital Experiments**
- Facility for pressurized payloads in e.g. Orbital Cygnus, Dream Chaser, Space Rider
- Facility for utilization in balloons and/or Sounding Rockets

**Post ISS and beyond LEO**
- Possible collaborations with commercial platforms
- Possible commercial exploitation of a Cis-lunar Station
About Space Applications Services

Space Applications Services NV/SA is an independent Belgian company founded in 1987, with a subsidiary in Houston, USA and an office in The Netherlands. Staff of 90, and growing.

Our aim is to research and develop innovative technology, solutions and services for the aerospace and security markets and related industries:

- Research and develop technologies for specific domains or subsystems which may be used stand alone or integrated within an overall system.
- Services to design, develop and integrate scientific and technology payloads, mission critical systems, facilities and command and control centres. Including laboratory, workshop and clean room.
- Services to operate facilities and command and control centres and to train persons to perform operations.

The company capabilities cover system, software and operations engineering and our activities include manned and unmanned spacecraft, launch/re-entry vehicles, monitor and control, robotics and information systems.